



1- Consider the following production plan:

Month	Beginnin inventory	Demand	Required productio	Number workers	Actual producti
Januar	200	500	300	15	660
Februa	360	600	'?	15	660
March	'?	650	'?	15	660

- How many units are produced by each worker?
 - How many units must be produced in February if no shortages are allowed?
 - What is the beginning inventory for March for the given plan?
 - What is the total inventory cost incurred for this plan if it costs \$ 12 per year to hold one unit in inventory?
 - What would you call this plan?
 - Is it optimal? Explain.
- 2- Poseidon Meter, Inc.. Makes a variety of water meters. Data for the past year indicate a worker can make, on average, 100 meters per four-week period. The inventory holding cost is computed to be \$ 1 per meter per period. Backorders, if allowed, cost about \$2 per meter per period. New workers can be hired, at a cost of \$ 1000 per worker, and existing workers can be laid off at a cost of \$2000 per worker. Workers are paid \$1500 per period. There are currently 10 workers at Poseidon. The forecast for the next four periods is 1200, 1200, 1000, and 1000 meters, respectively.
- Develop a zero inventory plan for the next four periods.
 - Develop a constant work force plan (no backorders) for the next four periods.
 - Develop a constant work force plan (with no more than 50 backorders allowed) for the next four periods.
 - Which plan would you recommend, and why?



- 3- X-Print Manufacturing makes laser printers. One plant assembles the PL-4000 model. Standards indicate that one worker can assemble five printers per day. This model costs about \$350 to make, and the company figures it costs \$5 to hold one printer in inventory for one month. Workers earn \$ 1500 per month and can be hired for \$500 each; firing a worker costs \$750. Currently, there are 12 workers in the assembly department. If a printer is backordered, the cost is \$35 per unit per month.

Month	July	August	September	October	November	December	Total
Working Days	21	22	21	23	19	20	126
Demand	1020	950	800	1000	1250	650	5670

- (a) Develop a zero inventory plan for this problem.
- (b) Develop a constant work force plan when no backorders are allowed.
- (c) Because this plan does not consider backorders, your boss asks you to develop a constant work-force plan that allows backorders. Which is the better plan?
- (d) Due to a long-range capacity plan, the assembly department will be relocated, which requires the department to shut down. There are two possible times for this to happen. One is to shut down for four days in October, and the other will necessitate an eight-day shutdown in December. Which plan would you recommend?
- 4- Jerry is production manager for the Proto Plastics Company. They make two major items widgets and gizmos. Demand history, by month, for the last two years is given. You have recently been hired at Proto, and Jerry has asked you to plan production for the next year. It takes a worker two days to make a widget and three days to make a gizmo. Currently, there are 32 workers at the plant. To hire a new worker costs \$700, and to lay off an existing worker costs \$1000. Workers are paid \$2000 per month. A widget costs \$250 to make, and a gizmo costs \$380. The inventory-cost carrying rate for Proto is 36 percent per year. Backorders are not allowed. Develop a monthly aggregate production plan and work-force levels for months 25 through 30.



Year1			Year2		
Month	Widgets	Gizmos	Month	Widgets	Gizmos
1	101	200	13	102	222
1	97	197	14	102	220
3	94	196	15	97	225
4	102	200	16	110	222
5	101	202	17	92	227
6	92	209	18	102	228
7	97	207	19	110	232
8	91	216	20	92	234
9	103	212	21	102	242
10	92	220	22	107	236
11	97	216	23	103	241
12	91	218	24	91	239

- 5- The SkAtZ company has forecast demand for in-line skates to be 56, 84, 108, and 59 thousand cases for the next four quarters. There is an initial inventory of 20,000 cases, and it costs \$50 per month to hold a case in inventory. Customers will backorder, but there is a loss-of-goodwill cost of \$250 per case. Production capacity and costs are as follows:

Period	1	2	3	4
Internal capacity (1000 cases)	60	70	60	55
Subcontracting capacity (1000 cases)	40	40	40	40
Internal costs (\$100/case)	20	21	23	22
Subcontracting costs (\$100/case)	22	28	30	28



Using a spreadsheet, determine a feasible aggregate production plan for next year. What are the advantages and disadvantages of your plan?

- 6- Eastern Electric makes washers and dryers. The production requirements for aggregate units are given in the table below. An employee can produce 20 units per month on regular time and can produce an additional two units per month on overtime. Currently, 25 people are employed with no overtime being used. New workers can be hired, but there is a \$950 per employee cost; layoff costs are \$ 1500 per employee. Regular-time salary is \$ 1750 per employee per month with overtime costs of \$180 per unit per employee. Carrying costs are \$15 per unit per month, and backorder costs are \$30 per unit per month. There is currently no inventory on hand. Develop an aggregate plan for the next five months.

Month	1	2	3	4	5
Demand	450	550	600	625	675

- 7- Develop and solve a linear program to determine an optimal plan for problem 2. Assume no more than 50 backorders are allowed in any period. How does it compare with spreadsheet solution?
- 8- Consider X-Print manufacturing (problem 3).
- (a) Give the constraints for the first month of a linear programming formulation for this problem. Assume backorders are allowed and, in any month no more than a 25 percent change in work force is allowed.
 - (b) Determine an optimal plan for the company. How does it compare with the spreadsheet plan?
 - (c) Due to stiff competition in the laser printer market, X-print wants to reexamine its backorder policy. What backorder cost would make the no-backorder case better than the backorder case?
 - (d) Does the linear programming formulation answer the question of when to relocate the assembly department? If so, how? If not, can it be modified to do so?
- 9- Develop and solve a linear programming model for problem 6. Compare it with spreadsheet solution.